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Mark Scheme (Results)

January 2022

Pearson BTEC Nationals
In Applied Science (31619H)
Unit 3: Science Investigation Skills

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Unit 3: Science Investigation Skills

General marking guidance

- All learners must receive the same treatment. Examiners must mark the first learner in exactly the same way as they mark the last.
- Marking grids should be applied positively. Learners must be rewarded for what they have shown they can do, rather than be penalised for omissions.
- Examiners should mark according to the marking grid, not according to their perception of where the grade boundaries may lie.
- All marks on the marking grid should be used appropriately.
- All the marks on the marking grid are designed to be awarded. Examiners should always award full marks if deserved. Examiners should also be prepared to award zero marks, if the learner's response is not rewardable according to the marking grid.
- Where judgement is required, a marking grid will provide the principles by which marks will be awarded.
- When examiners are in doubt regarding the application of the marking grid to a learner's response, a senior examiner should be consulted.

Specific marking guidance

The marking grids have been designed to assess learner work holistically. Rows in the grids identify the assessment focus/outcome being targeted. When using a marking grid, the 'best fit' approach should be used.

- Examiners should first make a holistic judgement on which band most closely matches the learner's response and place it within that band. Learners will be placed in the band that best describes their answer.
- The mark awarded within the band will be decided based on the quality of the answer, in response to the assessment focus/outcome and will be modified according to how securely all bullet points are displayed at that band.
- Marks will be awarded towards the top or bottom of that band, depending on how they have evidenced each of the descriptor bullet points.

BTEC Next Generation Mark Scheme

Section 1 – Biology

Question Number	Answer	Additional Guidance	Mark
1 (a)	results table containing: suitable headings with units (1) measurements consistently recorded to the same number of decimal places (1) repeats and means given (1)	 Unit is not required on mean column Ignore units in body of table Ignore absence or presence of hanging zeros	3
1 (b)	 labels and units for axes (1) suitable scales (1) all bars drawn correctly (1)	Allow axes either way round Spread of graph should cover at least half the graph paper given, in both directions Accept with or without gaps between bars if consistent Allow +/- ½ small square If numbers of the y-axis are taken directly from the table in the order of the table then do not award mp2/ allow a maximum of 2 marks If a line graph is drawn then do not award mp3- allow a maximum of 2 marks	3
1 (c)	maximum percentage cover at North (1) description of the trend/ reduction towards the South (1)	ORA Answer consistent with results and graph Accept examples to support the trend Ignore reference to anomalous results	2

1 (d)	Any one from: • local wildlife • pollen/ allergic reaction • poisonous plants/ fungi/ thorns • weather conditions e.g. sunburn • traffic/ roads • streams/ rivers • failing branches Accept any other reasonable response.	ignore uneven surface	1
1 (e)(i)	{chemical/physical/non-living} features (1) example of an abiotic feature (1) that {influence/affects} (distribution of) {an ecosystem/ organisms} (1)		2
1 (e)(ii)	Award one mark for identification and up to two marks for linked expansion. Any point may count as identification or expansion depending on how learners structure their answer. **Identification** as the light intensity increases the percentage cover decreases (1) **Expansion** growth is reduced as light intensity increases (1) (because) higher light intensity increases the temperature (1) {dries out/dehydrates/desiccates} the *Pleurococcus* (1) data used to support the explanation (1)	Accept ORA	3
1 (f)	Two from: bark less likely to be damaged/affected by animals/plants (1) closer to eye level (1) when comparing different trees, keeps one variable controlled (1) Humidity/moisture varies with height above ground (1) Accept other relevant responses.		2
		Total	**16 marks**

Question Number	Answer	Additional Guidance	Mark
2 (a)	substitution (1) (0.05/7600) x 100 evaluation (1) 0.000658 or 6.58×10^{-4}	Accept any value that rounds up to 0.0007	2
2 (b)(i)	no significant difference (1) between the (mean) percentage cover (of algae) on the {oak and pine/two types of} trees (1) OR the type of tree will have no effect on the percentage cover (1) any difference is due to chance (1) OR any difference between mean percentage cover of the pine and oak trees (1) is due to chance (1)	Do not credit reference to *results* being significant	2
2 (b)(ii)	**difference in the mean (2)** substitution 90.1– 89.9 evaluation = 0.2 **standard error (2)** substitution $(4.41^2/15 + 1.98^2/15)$ evaluation 1.558 **square root (1)** √1.558 ***T* evaluation (1)** (0.2 /1.2482)	0.16 (or any number that rounds to 0.16) alone gets 6 marks ecf throughout the response 0.2 alone could be awarded 2 marks for finding the difference	6
2 (b)(iii)	substitution (1) (15+15) – 2 evaluation (1) 28	28 alone is awarded full marks ecf	2

2 (b)(iv)	2.048	ecf from 2biii Accept indication in the table	1
2 (b)(v)	the null hypothesis should be **accepted** (1) (because) 0.17/*t* test value is less than 2.048/critical value (at (or above) the 95% confidence level/at the p = 0.05 significance level) (1) (therefore) {there is a not a significant difference/ difference is due to chance} (between the mean percentage cover of alga on the oak and pine trees) (1)	ecf Accept at the 95% confidence level ecf from *t* value and critical value for whole response Ignore "the 'results' are not significant"	3
		Total	**16 marks**

Question Number	Answer	Additional Guidance	Mark
3 (a)(i)	high wind speed could have removed some algal growth (1) OR wind dries out the *Pleurococcus/* reduces moisture *(1)* AND therefore lowered percentage cover/given false reading/ less growth (1) Accept any other valid response. wind could drive rain onto the trunk, increasing the water available to Pleurococcus/wind could blow colonising Pleurococcus (cells/spores) onto trunk(1) AND increase its percentage cover (1)	Allow 'wind lowers the temperature'	2
3 (a)(ii)	Two from: • temperature • carbon dioxide level (in air) • pH of rain • air pollution/SO_2 level • damage by humans/animals • infection • {species/type} of tree • {age/circumference/width} of tree • {rain/water} running down tree trunk • humidity (of air) Accept any other valid response.	ignore wind ignore light ignore 'weather' unqualified ignore height/ size of tree	2

3 (b)	Any two pairs from: take/repeat more samples using the same method (1) to check concordance/assess the reliability/ identify anomalies (1) OR use {machine/technology/photography} to estimate percentage cover (rather than by eye)/other sensible suggestion, e.g. scrape off algae and weigh, for each quadrat (1) to make results more precise/reduce error/ give empirical data (1) OR use smaller squares on the mini quadrats (1) smaller increments to count/gives more intervals for sampling (1)	Accept 'to give more reliable results'	4
		Total	**8 marks**

Section 2 – Chemistry

Question Number	Indicative content
4	A plan that makes reference to: <u>a hypothesis</u> • as the number of carbon increases the amount of energy produced per gram increases. • more carbon atoms means greater change in energy between bonds broken and bonds made in products, so more energy released overall • more carbon atoms means a greater density of chemical energy stored in the alcohol that can be released <u>equipment, techniques and procedures</u> <u>equipment examples:</u> • alcohol burners to hold different alcohols • thermometer to measure temperature • metal calorimeter so good heat transfer to water • measuring cylinder to measure volume of water • balance to measure the mass of the alcohol burner (accurate to 2 decimal places) • clamp and stand to hold calorimeter and ensure it is at the same height each time • ruler to measure distance of calorimeter from burner and length of wick <u>technique example:</u> • measure initial mass of alcohol burner • measure 100ml of water into calorimeter

	• light alcohol burner and wait for temperature to rise 20 degrees • put out flame • measure final mass of alcohol burner • repeat with the other alcohols *allow any other valid method* *risks and hazard examples* • risk of burning from flame or hot calorimeter • risk of scalding by hot water • do not touch directly / whilst hot • wait to cool down before handling • alcohol is flammable • keep away from naked flames whilst not using dependent variable • change in mass of alcohol • determined by weighing the alcohol burner • subtraction of final mass from initial mass • masses will be measured with a balance that measured to 2 decimal places independent variable • the alcohol burned • number of carbons in each alcohol burned • measure 5 alcohols with 1-5 carbons control variable examples • same volume of water – use a measuring cylinder to measure • same distance of calorimeter from wick of alcohol burner – use a ruler to measure • same temperature increase – use the thermometer • same size wick – use a ruler data collection Table or example graph to include • names of each fuel • initial and final mass of alcohol burner for each fuel • change in mass for each fuel • initial and final temperature for each fuel • change in temperature for each fuel analysis • subtract initial mass from final mass • subtract initial temperature from final temperature • calculate energy change for each alcohol • m x C x ΔT • calculate change in energy per gram of alcohol burned • plot graph of energy change per gram of alcohol vs number of carbons in alcohol • expected to show positive correlation / proportionality if hypothesis correct

Mark scheme (award up to 12 marks)
Refer to the general marking guidance found in this document on how to apply levels- based mark schemes.

Level	Mark	Descriptor
Level 0	0	No awardable content
Level 1	1-3	• Limited attempt at a hypothesis is made • Demonstrates limited knowledge and understanding of scientific concepts, procedures, processes and techniques with a basic description of the plan to investigate the scientific scenario given • Provides a rationale for the method suggested and generic statements may be presented rather than linkages being made so that lines of scientific reasoning are unsupported or unclear • The plan will not be logically ordered with significant gaps that will not lead to reliable results being collected
Level 2	4-6	• An explanation for the hypothesis is given which is partially supported by scientific understanding • Demonstrates adequate knowledge and understanding of scientific concepts, procedures, processes and techniques with a partial description of the plan to investigate the scientific scenario given • Provides a rationale for the method which has occasional linkages present so that lines of scientific reasoning are partially supported • The plan will generally be in a logical sequence and will yield some results
Level 3	7-9	• An explanation for the hypothesis is given which is supported by scientific understanding • Demonstrates good knowledge and understanding of scientific concepts, procedures, processes and techniques with a clear description of the plan to investigate the scientific scenario given • Provides a rationale for the method which has linkages present so that lines of scientific reasoning are supported • The plan will be in a logical sequence but with minor omissions of steps and will yield reliable results
Level 4	10-12	• An explanation for the hypothesis is given which is fully supported by scientific understanding • Demonstrates comprehensive knowledge and understanding of scientific concepts, procedures, processes and techniques with a step by step description of the plan to investigate the scientific scenario given • Provides a rationale for the method which has consistent linkages present so that lines of scientific reasoning are fully supported • The plan will be in a logical sequence and will lead to a reliable set of results being collected
		Total marks for Question 4 = 12 marks

Question Number	Indicative content
5	An evaluation that makes reference to: <u>Method</u> • did not determine the mass of the piece of snack • did not state how the amount of water was measured • did not state that the same volume of water to be heated was used each time. • did not say how the temperature was measured • did not say the degree of accuracy with which to measure the temperatures • did not say how to light to the snack • did not say what to do if the snack burned out /how long to hold the snack under the test tube • did not state a distance to hold snack from test tube <u>Results</u> • did not repeat the experiment • so could not calculate an average or identify anomalies • only measured to nearest degree • did not calculate a temperature change • should calculate energy or temperature change per gram of snack <u>Conclusion</u> • conclusion is not correct • final temperature is highest for onion rings, initial temperature/ temperature change has not been considered • highest temperature change is for the bacon fry at 33°, temperature change for onion rings is only 32°C • lowest temperature change is for prawn cocktail shell so this part of the conclusion is (unintentionally) correct • however temperature change has not been worked out per gram of food so no definite conclusion can be drawn • some pieces of snack may have been bigger / different shape / different surface area to than others, which is why the rise is higher • need to carry out more experiments and measure the change in mass each time.

Mark scheme (award up to 8 marks)
Refer to the general marking guidance found in this document on how to apply levels-based mark schemes.

Level	Mark	Descriptor
	0	No awardable content
Level 1	1-2	• Adequate interpretation and analysis of the scientific information • Generic evaluative comments made with little linkage to supporting evidence/reference to context • A conclusion may be presented, but will lack focus and be superficial and underdeveloped
Level 2	3-5	• Good analysis and interpretation of the scientific information • Evaluative comments with supporting evidence/reference to context and a partially developed chain of reasoning • Conclusion will be mostly focused and developed and draw upon some of the information presented before
Level 3	6-8	• Comprehensive analysis and interpretation of all pieces of scientific information • Evaluative comments supported by relevant reasoning and appropriate reference to context • Conclusion will be clear and concise and well developed drawing upon the most relevant information presented before

Ofqual
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